



Understanding the Threat of Healthcare-Associated Antibiotic Resistance and the Tools Available to Prevent It

NVAC Briefing February 2015

L. Clifford McDonald, MD

Senior Advisor for Science

Division of Healthcare Quality Promotion
National Center for Emerging and Zoonotic Infectious Diseases
Centers for Disease Control and Prevention





ANTIBIOTIC RESISTANCE THREATS in the United States, 2013

Using CDC's data to describe the domestic impact of antimicrobial resistance

Estimated minimum number of illnesses and deaths caused annually by antibiotic resistance*:

At least

 **2,049,442** illnesses

 **23,000** deaths

**bacteria and fungus included in this report*

Antibiotic Resistant Threats

Healthcare-Associated Pathogens

- Urgent
 - Carbapenem resistant Enterobacteriaceae
 - Drug-resistant gonorrhea
 - *Clostridium difficile*
- Serious
 - Multidrug-resistant Acinetobacter
 - Drug-resistant Campylobacter
 - Fluconazole-resistant Candida
 - Extended spectrum β -lactamase Enterobacteriaceae

Antibiotic Resistant Threats cont'd

Healthcare-Associated Pathogens

- Serious cont'd
 - Vancomycin-resistant enterococcus
 - Multidrug-resistant *Pseudomonas aeruginosa*
 - Drug-resistant non-typhoidal salmonella
 - Drug-resistant salmonella serotype typhi
 - Drug-resistant shigella
 - Methicillin-resistant *Staphylococcus aureus*
 - Drug-resistant *Streptococcus pneumoniae*
 - Multidrug-resistant Tuberculosis

Antibiotic Resistant Threats cont'd

Healthcare-Associated Pathogens

- Concerning
 - *Vancomycin-resistant Staphylococcus aureus*
 - Erythromycin-resistant Group A streptococcus
 - Clindaymcin-resistant Group B steptococcus



CARBAPENEM-RESISTANT ENTEROBACTERIACEAE

9,000 DRUG-RESISTANT INFECTIONS PER YEAR

600 DEATHS

THREAT LEVEL **URGENT** ○○○○○○

⚠️ CRE HAVE BECOME RESISTANT TO ALL OR NEARLY ALL AVAILABLE ANTIBIOTICS ⚠️



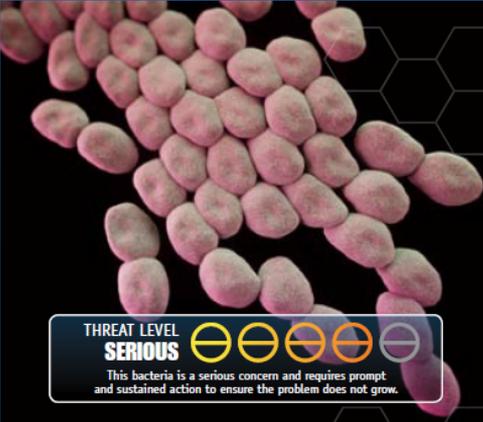
CLOSTRIDIUM DIFFICILE

250,000 INFECTIONS PER YEAR

14,000 DEATHS

THREAT LEVEL **URGENT** ○○○○○○

\$1,000,000,000 IN EXCESS MEDICAL COSTS PER YEAR



MULTIDRUG-RESISTANT ACINETOBACTER

7,300 MULTIDRUG-RESISTANT ACINETOBACTER INFECTIONS

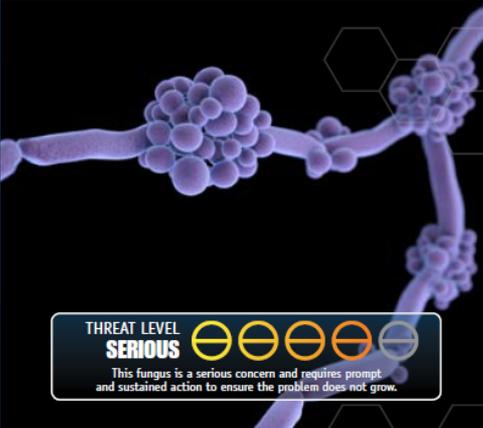
500 DEATHS FROM MULTIDRUG-RESISTANT INFECTIONS

12,000 ACINETOBACTER INFECTIONS PER YEAR

AT LEAST THREE DIFFERENT CLASSES OF ANTIBIOTICS
NO LONGER CURE
RESISTANT ACINETOBACTER INFECTIONS

THREAT LEVEL SERIOUS ○○○○○○

This bacteria is a serious concern and requires prompt and sustained action to ensure the problem does not grow.



FLUCONAZOLE-RESISTANT CANDIDA

3,400 FLUCONAZOLE-RESISTANT CANDIDA INFECTIONS

220 DEATHS

46,000 CANDIDA INFECTIONS PER YEAR

THREAT LEVEL SERIOUS ○○○○○○

This fungus is a serious concern and requires prompt and sustained action to ensure the problem does not grow.



EXTENDED SPECTRUM β -LACTAMASE (ESBL) PRODUCING ENTEROBACTERIACEAE

26,000 DRUG-RESISTANT INFECTIONS

1,700 DEATHS

140,000 ENTEROBACTERIACEAE INFECTIONS PER YEAR

\$40,000 IN EXCESS MEDICAL COSTS PER YEAR FOR EACH INFECTION

THREAT LEVEL SERIOUS ○○○○○○

This bacteria is a serious concern and requires prompt and sustained action to ensure the problem does not grow.

For a fully compliant version of this image, go to page 20



VANCOMYCIN-RESISTANT ENTEROCOCCUS (VRE)

THREAT LEVEL
SERIOUS ○○○○○○
 This bacteria is a serious concern and requires prompt and sustained action to ensure the problem does not grow.

20,000 DRUG-RESISTANT ENTEROCOCCUS INFECTIONS

1,300 DEATHS FROM DRUG-RESISTANT ENTEROCOCCUS INFECTIONS

66,000 ENTEROCOCCUS INFECTIONS PER YEAR

SOME ENTEROCOCCUS STRAINS ARE RESISTANT TO VANCOMYCIN **LEAVING FEW OR NO TREATMENT OPTIONS**



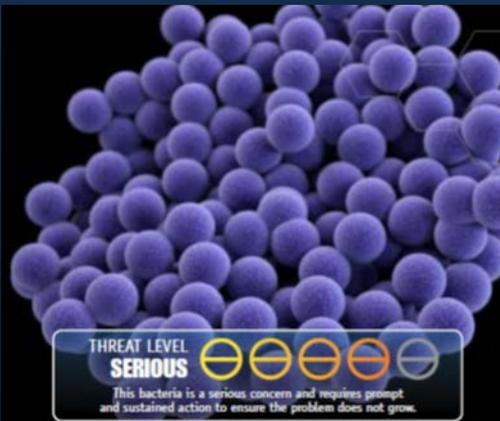
MULTIDRUG-RESISTANT PSEUDOMONAS AERUGINOSA

THREAT LEVEL
SERIOUS ○○○○○○
 This bacteria is a serious concern and requires prompt and sustained action to ensure the problem does not grow.

6,700 MULTIDRUG-RESISTANT PSEUDOMONAS INFECTIONS

440 DEATHS

51,000 PSEUDOMONAS INFECTIONS PER YEAR



METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA)

THREAT LEVEL
SERIOUS ○○○○○○
 This bacteria is a serious concern and requires prompt and sustained action to ensure the problem does not grow.

80,461 SEVERE MRSA INFECTIONS PER YEAR

11,285 DEATHS FROM MRSA PER YEAR

STAPH BACTERIA ARE A LEADING CAUSE OF **HEALTHCARE-ASSOCIATED INFECTIONS**



VANCOMYCIN-RESISTANT STAPHYLOCOCCUS AUREUS

THREAT LEVEL
CONCERNING ○○○○○○
This bacteria is concerning, and careful monitoring and prevention action are needed.



13 CASES

IN **4** STATES SINCE 2002

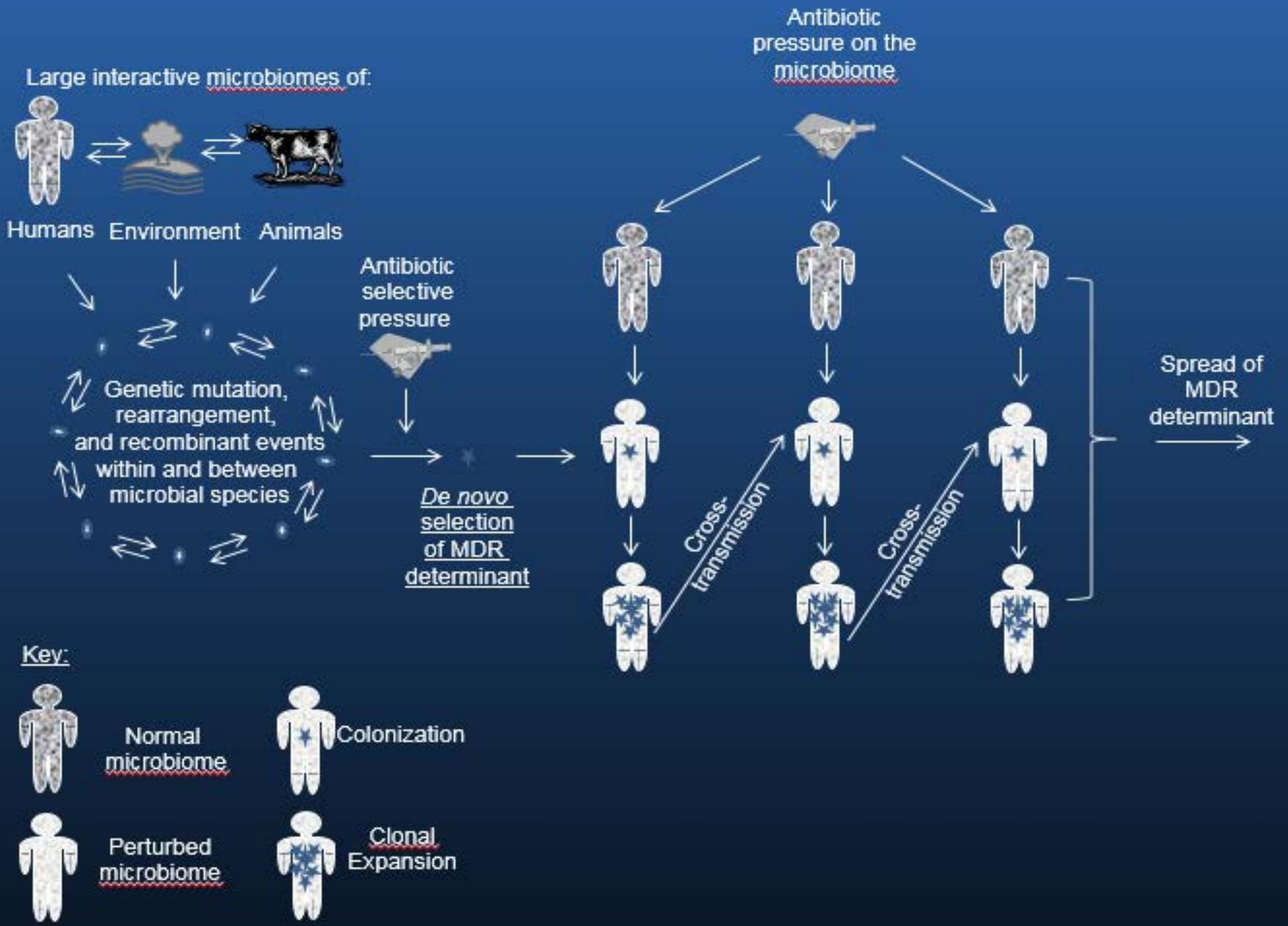


SOME STAPHYLOCOCCUS STRAINS ARE RESISTANT TO VANCOMYCIN
LEAVING FEW OR NO TREATMENT OPTIONS



Shared Factors of Antibiotic Resistant Healthcare Pathogens

- Epidemiologic factors
 - Direct and indirect contact transmission between patients
 - Colonized patients exceed those infected
 - Colonization precedes infection by days to weeks and may last weeks to months and even years after
- Where colonization occurs
 - Pathologic biofilms
 - Body sites normally inhabited by a complex and diverse human microbiota



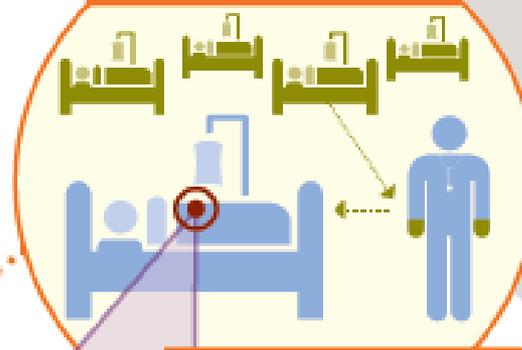
Risk of CRE Infections

1. Local Short-Stay Hospital



Jan has a stroke and is in the hospital. She is stable but needs long-term critical care at another facility.

2. Long-Term Acute Care Hospital



Other patients in this facility have CRE. A nurse doesn't wash his hands, and CRE are spread to Jan. She develops a fever and is put on antibiotics without proper testing.

3. Local Short-Stay Hospital



Jan becomes unstable and goes back to the hospital, but her new doctors don't know she has CRE. A doctor doesn't wash her hands after treating Jan. CRE are spread to other patients.

How CRE Take Over

1. Lots of germs, 1 or 2 are CRE



2. Antibiotics kill off good germs



3. CRE grow



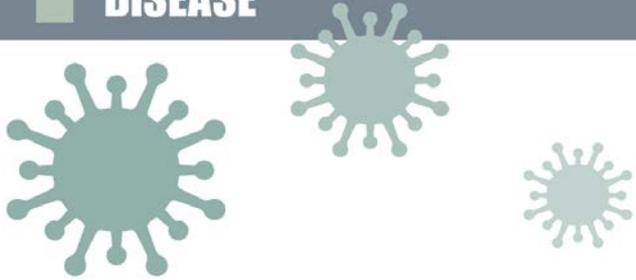
4. CRE share genetic defenses to make other bacteria resistant



SOURCE: CDC Vital Signs, 2013

Fighting back against antibiotic resistance

1 PREVENTING INFECTIONS, PREVENTING THE SPREAD OF DISEASE



2 TRACKING



3 IMPROVING ANTIBIOTIC PRESCRIBING AND USE, AKA "STEWARDSHIP"

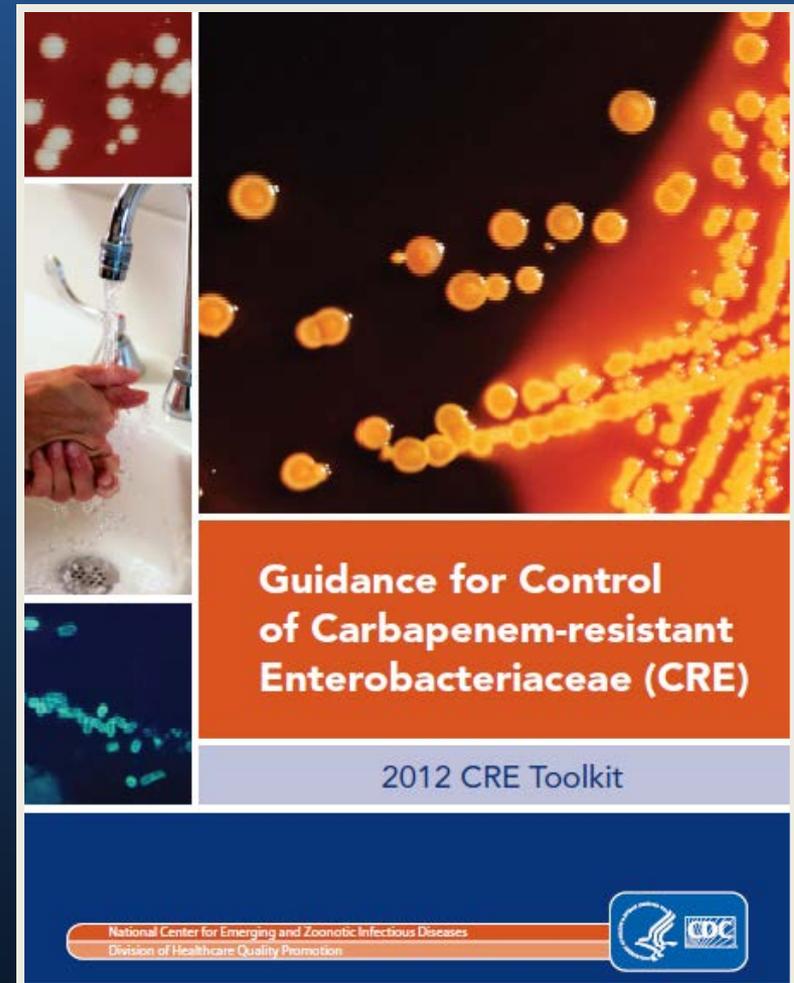


4 DEVELOPING NEW DRUGS



CDC CRE Toolkit – 2012

- Facility-level recommendations
- Regional prevention strategy for health department implementation



Key Domestic Initiatives

- Measuring antibiotic use and improving antibiotic prescribing for inpatients and outpatients
- Expanding surveillance to capture antibiotic resistance data from hospital electronic laboratory records
- Creating new regional collaborative to prevent the spread of resistance between healthcare institutions
- Expanding public health laboratory capacity to detect, characterize, and track antibiotic resistant pathogens

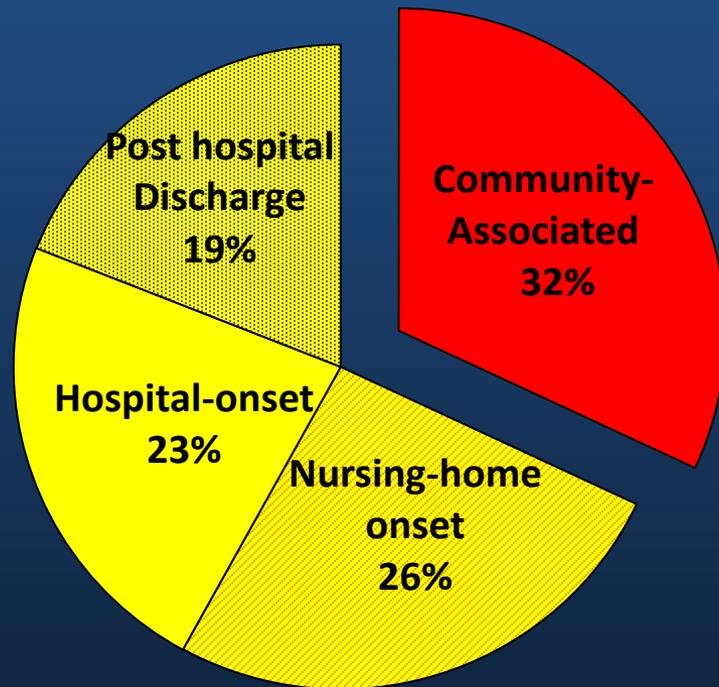
Tracking Resistance Patterns

Tracking Networks	Data Collected	Resistant Organisms
Emerging Infections Program (EIP)	Network of public health-academic hospital collaborations in 10 states	<ul style="list-style-type: none"> • <i>Streptococcus pneumoniae</i> • Groups A and B <i>Streptococcus</i> • MRSA • <i>C. difficile</i> • Candida (a fungus) • CRE • MDR Acinetobacter • <i>Salmonella</i> • <i>Campylobacter</i> • <i>Shigella</i>
National Antimicrobial Resistance Monitoring System (NARMS)	Collaboration among CDC, FDA, USA, and state/local health departments	<ul style="list-style-type: none"> • <i>Salmonella</i> • <i>Campylobacter</i> • <i>Shigella</i>
National Healthcare Safety Network (NHSN)	Network of over 12,000 healthcare facilities	<ul style="list-style-type: none"> • Healthcare-associated infections
Gonococcal Isolate Surveillance Program (GISP)	Track resistance in STD clinics in 28 cities	<ul style="list-style-type: none"> • <i>Neisseria gonorrhoeae</i>
National Tuberculosis Surveillance System (NTSS)	Includes data from all 50 states and the US territories	<ul style="list-style-type: none"> • <i>Mycobacterium tuberculosis</i>

Epidemiology for Vaccine Development

Distribution of *Clostridium difficile* Infections by Location at Time of Diagnosis, Emerging Infections Program, 2010

CDI Cases (N=10,342)*

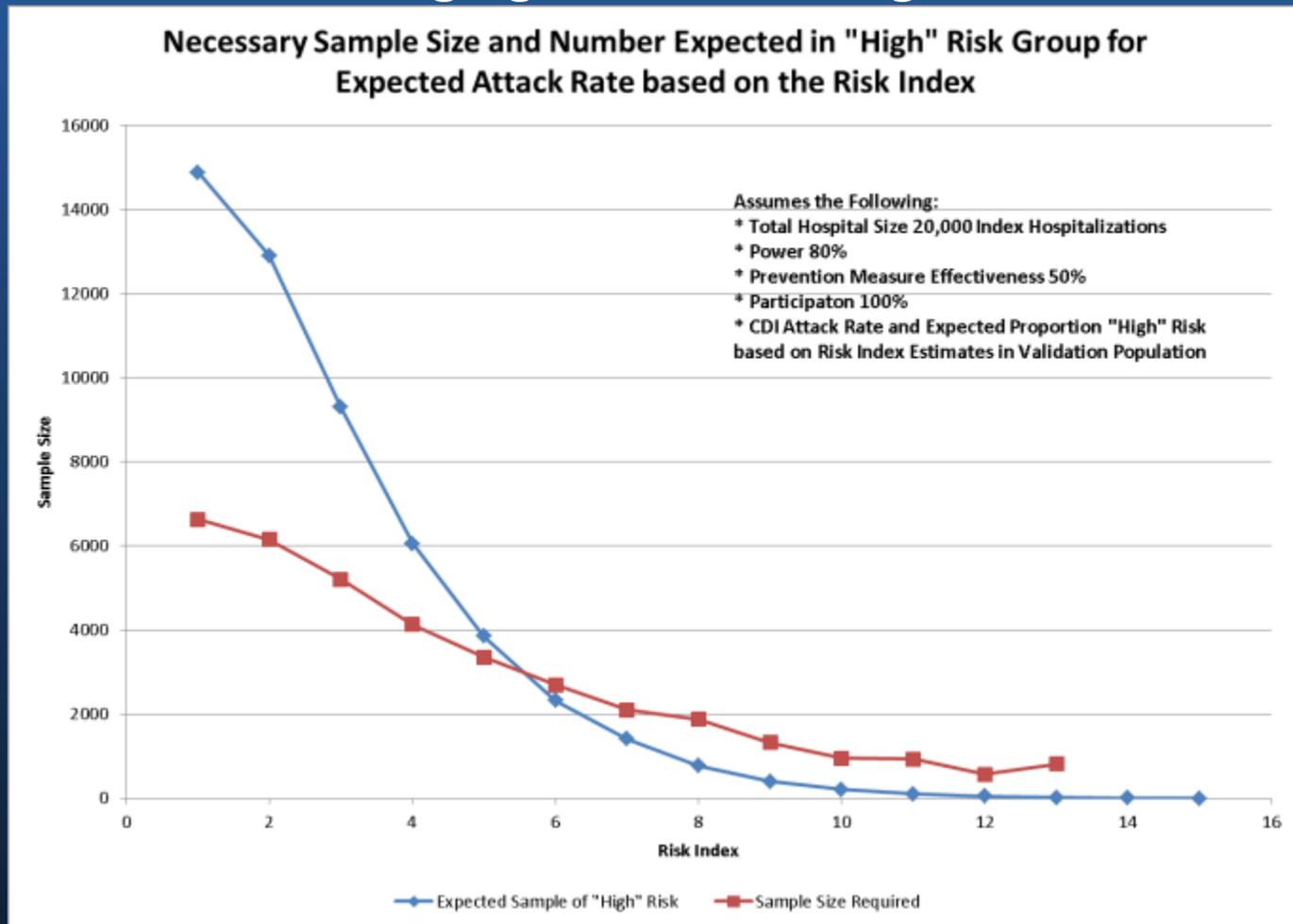


- 82% have had at least one outpatient healthcare exposure in the 12 weeks prior to symptoms onset
- 18% (only 6% of total) have had no healthcare exposure

* EIP Sites: California, Colorado, Connecticut, Georgia, Minnesota, New York, Oregon, and Tennessee

Epidemiology for Vaccine Development

Emerging Infections Program





Saving Lives.
Protecting People.™

**LEARN MORE ABOUT HOW
CDC WORKS FOR YOU.**



Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333

Phone: 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348

E-mail: cdcinfo@cdc.gov

Web: www.cdc.gov

FLUCONAZOLE-RESISTANT CANDIDA

THREAT LEVEL SERIOUS

This fungus is a serious concern and requires prompt and sustained action to ensure the problem does not grow.

3,400 FLUCONAZOLE-RESISTANT CANDIDA INFECTIONS

220 Deaths

46,000 CANDIDA INFECTIONS PER YEAR

Risk of CRE Infections

1. Local Short-Stay Hospital

Jane has a stroke and is in the hospital. She is stable but needs long-term critical care at another facility.

2. Long-Term Acute Care Hospital

Other patients in this facility have CRE. A nurse doesn't wash his hands, and CRE are spread to Jan. She develops a fever and is put on antibiotics without proper testing.

3. Local Short-Stay Hospital

Jan becomes unstable and goes back to the hospital, but her new doctors don't know she has CRE. A doctor doesn't wash her hands after treating Jan. CRE are spread to other patients.

How CRE Take Over

1. Lots of germs, 1 or 2 are CRE
2. Antibiotics kill off good germs
3. CRE grow
4. CRE share genetic defenses to make other bacteria resistant

Fighting back against antibiotic resistance

1. Preventing infections, preventing the spread of disease
2. Tracking
3. Improving antibiotic prescribing and use, AKA 'stewardship'
4. Developing new drugs